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Assessment of the Quality of Sachet Water produced in Zaria and Environs

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ABSTRACT:
The increasing demand for clean drinking water due to the growing population has led to the upsurge of private water supply companies. Consumption of pipe borne water and from other untreated sources has resulted to outbreak of numerous reported ailments. This prompted several studies on water quality assessment and availability including this study. This study assessed the quality of water produced by different water supply companies. The physicochemical parameters and coliform were assessed using standard chemical and biological analyses respectively. A total of 30 sachets water were sampled from Zaria, Giwa and Sabon Gari Local Government Areas in Kaduna state. The results of the quality parameters; turbidity, pH, BOD, DO, Electrical conductivity were in a range of 0.61 - 2.06 NTU, 7.10 - 7.40 mg/l, 1.20 - 2.02 mg/l, 2.70 - 3.90 mg/l and 125 – 215 µs/cm respectively. Although, the values varied with respect to each parameter, all were found to be within the safe limits of the Nigeria industrial standard (NIS) 6.5-8.5, 100mg/l, 50 mg/l and 1000µs/cm. However, the values of Pb was found to be 0.19 – 0.23 mg/l in some water samples obtained in Zaria which is slightly above the permissible limit of 0.01mg/l WHO/NIS standard. Similarly, the results revealed the presence of some coliform bacterial in some same samples obtained from Zaria and Sabon Gari. From the results of the study, it showed that the treatment techniques adopted by most water supply companies were not effective and thus require significant improve in order to meet the national drinking water quality benchmark. It is recommended that to ensure clean and safe drinking water, strict adherence to the hygienic standards and safety guidelines set by Nigeria Industrial Standard (NIS) shall be observed. It is also recommended that adequate and enough treatments be done to reduce the coliform count to zero before consumption.

Keywords: Sachet water, physiochemical quality, coliform, heavy metal.

INTRODUCTION:

Water is life. It accounts for about 70% of the human body weight and 98% of neonatal body weight. Of the five basic human needs (water, food, health, education and peace) water is a common factor to the other four [1]. Adequate supply of water is central to life and civilization, this underscores the importance of water to man's survival especially for drinking, domestic, industrial and agricultural uses. [2] Water in its pure form is odourless, colourless and tasteless. However, anthropogenic activities such as the discharge of industrial effluent directly into a water source, improper sewage and waste water disposal, mining activities, oil leakage, and animal activities continue to challenge the quality of drinking water. The quality of drinking water is evaluated on the basis of its chemical components. This is done by assessing the pH, hardness, total alkalinity, dissolved oxygen, carbon dioxide, heavy metal and other organic/inorganic constituents [3].

Drinking water that is fit for human consumption is expected to be free from physical, bacteriological and heavy metals in an amount that can be hazardous to health [3]. Safe drinking water which is aesthetically acceptable is of high priority to National and international regulatory Agencies such as National Agency for Food, Drug and Administration Control (NAFDAC), National Industrial Standard (NIS), and World Health Organization (WHO). [4] There exists however, a difference between "pure water" and "safe drinking water". Pure water in the real sense does not contain any mineral, chemical and does not exist naturally (Environmental Protection Agency, 1999). Safe drinking water however, may contain naturally occurring minerals and chemicals such as calcium, potassium, sodium or fluoride which are actually beneficial to human health (United Nation Environmental Programme, 2008). The motive then, is to provide safe drinking water. One of the major and critical problems in most developing countries today is the provision of an adequate and safe drinking water to its populace [5].

In Zaria and its environs, water supply is limited to a few shallow wells 5-12 meters deep and an erratic water supply through the public taps from its water works. The need of locally sourced, low-cost

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alternative drinking water schemes is important. One of such initiatives in Nigeria is the advent of packaged drinking water sold in sachets [6].water is packed and sold in sealed 50cl sachet bags. It is commonly referred to as "pure water". This phenomenon of pure water has evolved over the years. It seeks to provide a "qualitative and safe" available drinking water to the thirsty public.

The objective of the study is to assess the quality of the sachet water produced in Zaria, Giwa, and Sabon gari local government area of Kaduna State and to compare the variations of the quality of the water produced in each location also to compared the result with the WHO standards in order to evaluate any possible health effect on the consumers. This is very important because drinking water quality guidelines and standards are designed to enable the provision of clean and safe water for human consumption, thereby protecting human health as well as the environment.

MATERIALS AND METHODS

Study Area

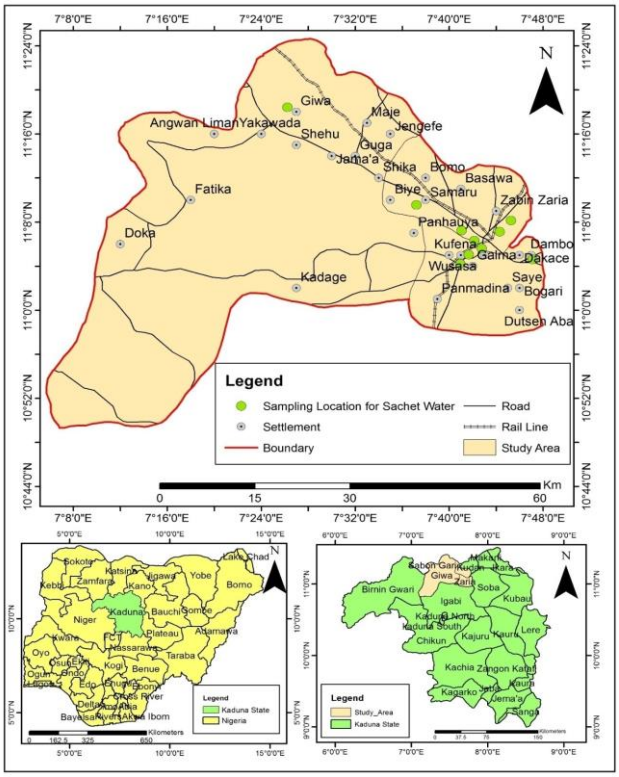

Figure 1: Map of study area showing sampling Location of sachet water.
Source :Adapted from the administrative map of Kaduna State

The study area comprises of three local government areas, Giwa, Zaria and Sabon gari local government area of Kaduna state, The study area is located in the northern part of Kaduna State, bordered by Futua Local Government Area of Katsina State on the north, to the northeast by Kudan Local Government Area, to the northwest by Birin Gwari Local Government Area and to the south by Igabi Local Government Areas of the State . (see Fig.1). it possesses a tropical continental climate. This is more pronounced during the dry season, especially December to January. It enjoys a total rainfall of up to 1050mm annually; its hottest month is usually April with an average temperature of 36.3°C. The high temperature of the area affects the consumption of sachet water. The primary sources of water of the area are surface and groundwater. Extensive agricultural production goes on in the region as it lies within the sudan savanna vegetation. It contains some geological features like Gneiss's and older granites with constituents like biotite, gneiss, peg malte, alphite, quartz, amphibiotite

SAMPLE COLLECTION

A total of thirty brands of the most popular sachet water samples produced in Giwa,Sabon Gari, and Zaria Local Government Areas in Kaduna State were proportionally selected in a ratio of 3:12:15 in respectively, three replicate samples from different lots were collected per brand and obtained from their production factory and they were labeled according to the initials of their Local Government area. The samples were kept for seven days and were carefully labeled and transported to the laboratory in an ice packed cooler for analysis, the physico-chemical properties, the presence of coliform bacteria and the level of heavy metals level contamination of the collected sachet water samples were assessed in the laboratory.

RESULTS AND DISCUSSIONS

The results of the quality parameters; Turbidity, pH, BOD, DO, Electrical conductivity were in a range of 0.61 - 2.06 NTU, 7.10 - 7.40 mg/l, 1.20 - 2.02 mg/l, 2.70 - 3.90 mg/l and 125 – 215 µs/cm respectively. Although, the values varied with respect to each parameter, all were found to be within the safe limits of the Nigeria industrial standard (NIS) 6.5-8.5, 100mg/l, 50 mg/l and 1000µs/cm. However, the values of pb was found to be 0.19 – 0.23 mg/l in some water samples obtained in Zaria which is slightly above the permissible limit of 0.01mg/l WHO/NIS standard. Similarly, the results revealed the presence of some coliform bacterial in some same samples obtained from Zaria and Sabon Gari. The results of the laboratory analyses are presented in the table below.

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TABLE 2 SHOWING THE RESULT OBTAINED FROM THE LABORATORY

PARAMETER	Giwa	S/Gari	Zaria	WHO/ NIS
pH(mg/l)	7.1	7.2	7.3	6.5-8.5
BOD (mg/l)	1.8	2.1	2.02	10
DO (mg/l)	3.9	3.64	2.7	5
Turbidity (mg/l)	0.608	2.06	1.54	5
E/C	125	147	215	1000
Cu	0.006	0.012	0.015	1.0
Fe	0.174	0.034	0.065	0.03
Pb	0.19	0.023	0.19	0.01
Zn	0.11	0.024	0.02	5.0
F C(Cfu/ml)	0	0	4	0
T C(Cfu/ml)	0	0	64	10

Source:Author's Findings(2016):the result shows the mean of the data collected

DISCUSSION

The water samples were colourless, odourless and tasteless. This compares favourably with the results obtained by [10]. The acceptable pH range by World Health Organization, is 6.5 (lower permissible limit) to 8.5 (upper permissible limit). The mean values for the thirty brands of the sachet drinking water had their pH values ranging from 7.1 to 7.4 which is within the permissible limit. The electrical conductivity values of these samples which gave the measures of the ionized substances in the samples at a particular temperature [5] ranged from 125-136 -and these were all below the 1000 µs/cm given for fresh waters by NIS and WHO.Thus, implying that these samples probably did not contain much ionized metals especially those that could pose serious health hazards.

The dissolved oxygen (DO) of the samples which gave the empirical values of their oxygen requirements for the oxidation of their organic matter ranged from 1.9-3.3 mg/l while the biochemical oxygen demand (BOD) which gave the relative oxygen requirements of their bacteria for the degradation of organic materials ranged from 0.6 – 2.1mg/l. These values were lower than the respective 10 and 5 mg/l reported as the maximum OD and BOD values of potable waters .The turbidity ranges from 0.32 – 1.54 also falls within the recommended limit 5 NTU. Thus the result of the physicochemical properties of sachet water produced in Zaria and its region falls with the recommended limited MPLs specified in the NIS drinking water standards and WHO guidelines. [7].

The maximum acceptable concentration (MAC) of pathogenic bacteria, mostly marked by the presence of faecal coliform or Escherichia coli in potable water, is none detectable coliforms per 100 ml although in some locations, 5 CFU/100 ml maximum counts are reported to be allowed for 90% of samples analysed for a year [8]. The coliform values of the samples in this study showed that some of the water samples were not fit for consumption as they had high coliform counts of 64, The bacteria isolated from the samples in this work included Klebiella and protein spp. Klebsiella spp. are Gram-negative, non-motile bacilli that belong to the family Enterobacteriaceae. identified as a pathogen.. On rare occasions, Klebsiella spp., notably K. pneumoniae and K. oxytoca, may cause serious infections, such as destructive pneumonia. Klebsiella can cause nosocomial infections, and contaminated water and aerosols may be a potential source of the organisms in hospital environments and other health care facilities.[9]

These pathogens were probably transferred into the samples from the environment especially through sewage and other humic matters or sources related to unhygienic conditions [3].

The level of contamination of heavy metal in the sachet water samples as shown in the table. Copper, zinc, lead and iron were tested but the result obtain was below the recommended limit which indicate that all the samples are free from the toxic effects. However, the concentrations of lead in all the samples were noticed to be slightly higher than the NIS permissible limit of less than 0.01mg/l. Though lead is needed by the body to satisfy its nutritional requirements, but only minute quantities are required as high doses lead to health hazards which are sometimes lethal.

CONCLUSION AND RECOMMENDATION

In conclusion, the overall results suggest the need for sachet water producers in Zaria and its environs to improve their quality measures, especially in terms of hygiene, and to ensure strict compliance with guidelines as set by Nigeria's quality regulatory body. This study revealed that the consumers of sachet-packaged drinking water could be at serious risk if necessary measures are not taken to improve quality. It is therefore recommended that in addressing the public health concerns that are being generated by the sachet-packaged drinking water phenomenon in Zaria,Giwa and Sabon Gari intensive efforts are required in educating the producers and consumers alike.

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